A National Program of Research for

PEANUTS

Prepared by

A JOINT TASK FORCE OF THE
U. S. DEPARTMENT OF AGRICULTURE
AND THE STATE UNIVERSITIES
AND LAND GRANT COLLEGES

FOREWORD

The United States Department of Agriculture and State Agricultural Experiment Stations are continuing comprehensive planning of research. This report is a part of this joint research planning and was prepared under recommendation 2 (page 204, paragraph 3) of the National Program of Research for Agriculture.

The task force which developed the report was requested to express their collective judgment as individual scientists and research administrators in regard to the research questions that need to be answered, the evaluation of present research efforts, and changes in research programs to meet present and future needs. The task force was asked to use the National Program of Research for Agriculture as a basis for their recommendation. However, in recognition of changing research needs it was anticipated that the task force recommendations might deviate from the specific plans of the National Program. These deviations are identified in the report along with appropriate reasons for change.

The report represents a valuable contribution to research plans for agriculture. It will be utilized by the Department and the State Agricultural Experiment Stations in developing their research programs. It should not be regarded as a request for the appropriation of funds or as a proposed rate at which funds will be requested to implement the research program.

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This report has been prepared in limited numbers. Persons having a special interest in the development of public research and related programs may request copies from the Research Program Development and Evaluation Staff, Room 318-E Administration Bldg., USDA, Washington, D.C. 20250.

November 1968

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PREFACE

Background:

The long-range study, "A National Program of Research for Agriculture," conducted by a joint USDA-SAES Task Force, was published in October 1966. One of the recommendations of the study called for a more systematic and continuing mechanism that would facilitate joint research program planning, evaluation, and coordination. The Agricultural Research Planning Committee recommended the establishment of task forces to develop coordinated State-Federal plans for specified areas of research. Subsequently, thirty-two task forces were established of which this is one.

Authority:

The Joint Task Force on Peanut Research was appointed in memoranda of Dr. G. L. Mehren, Assistant Secretary of Agriculture, and Director A. G. Hazen, Chairman of the Experiment Station Committee on Organization and Policy, dated March 5, 1968.

Membership:

USDA:

- R. W. Howell, Chief, Oilseed and Industrial Crops Research Branch, Crops Research Division, ARS CO-CHAIRMAN
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- J. L. Butler, Leader, Forage and Oilseeds Harvesting and Processing Investigations, Agricultural Engineering Research Division, ARS, Tifton, Georgia
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Assignment:

Peanut research in Research Problem Areas 207, 208, 209, 307, 308, 309, 405, 406, 407, 408, 501, and 504 was assigned to the task force.

SUMMARY

Introduction

Importance and nature of the industry:

- Mycotoxins one of most serious problems - a special statement included
- Peanuts among top 10 US crops - Of crops on >1 mil acres, only rice and potatoes are worth more per acre
- Three major producing areas: (1) Georgia, Florida, Alabama; (2) Texas, Oklahoma; (3) Virginia, Carolinas
- Four commercial peanut types: Runner, Spanish, Virginia, and Valencia
- More than half the peanuts used as food are used for peanut butter
- Per capita consumption 5.5 lbs.
- Per acre yields have risen in 20 years from 646 lbs. to 1765 lbs.
- Government efforts to assist the peanut industry through acreage control and price supports began in the mid-1930's.
- Government has purchased from 15-30% of the crop in recent years at a loss of up to $50 million annually
- Industrywide marketing agreement established in 1965 for regulating quality

Research perspective:

- Production has risen at a faster pace than utilization
- The widening gap between supply and demand has led to increasing concern over the public cost of support
- Two major areas of research opportunity: (1) more efficient production; (2) efforts to increase consumption
- Quality identification and measurement has been a persistent problem

- Peanut Improvement Working Group established to foster an exchange of information

- National Peanut Council encouraged research through an annual award

- Peanut Marketing Research Laboratory at Dawson, Georgia, to be operational in 1969

- TF recommends keeping research program flexible

Research Goals and Problem Areas

Protection: Goal II:

- Disease control expected to continue as a major problem for some time

- Important diseases at present are: leaf spots, seed and seedling diseases, root and stem diseases, and pod diseases

- Present control methods for peanut insects are unsatisfactory

- Present weed control methods costly--no chemical available for mid- or late-season

Production - Goal III:

- Good potential for increasing production per acre

- Irregular stands of plants and substandard vigor are limiting factors

- Erratic and sometimes negative response to fertilizer

- Mycotoxin problems greatly reduced if peanuts are not damaged in harvesting and handling and dried promptly to a moisture content of 8 or 9%

- Machinery presently available far from ideal

- Mathematical models needed to help evaluate production systems

- Consumer information needed that will guide production decisions

Product Development and Quality - Goal IV:

- Peanuts an excellent source of human food
- Basic studies of proteins and flavors needed along with development of new uses and improved products
- Emphasis needed on food uses
- Peanut hulls a serious problem - new uses urgently needed
- Need for quality identification, measurement, and maintenance

Marketing - Goal V:

- Many imperfections exist in marketing system; improvements in all handling and distribution activities needed
- Improved marketing efficiency could increase the attractiveness of peanuts and peanut products to consumers
- A continuing evaluation of the economics of marketing peanuts needed

INTRODUCTION

The charge to the Peanut Task Force was to envision areas of research which need emphasis in peanuts. In order to make meaningful recommendations it was believed worth-while to provide a brief perspective of the industry's setting in the national economy within a framework of historical developments. Also a statement pertaining to mycotoxins is included. In the opinion of members of the task force mycotoxins continue as one of the most serious problems challenging peanut researchers. A high priority is recommended for mycotoxin-related research. Other problem areas of related importance to peanuts but not assigned to this task force have been noted by cross reference. These problem areas include toxic residues, protection of food supplies from harmful microorganisms, soil and water use, drainage and irrigation.

A. Importance and Framework of the Peanut Industry

The peanut is a native South American legume. Forty-five million acres in the world are now devoted to this important food and vegetable oil crop. Peanuts rank in the top ten crops of the United States. Farm value including value of peanuts used for seed came to about $300 million in 1967. At the present time the national peanut allotment is 1.6 million acres. The average peanut yield in the U.S. in 1967 was 1,765 lbs. per acre. There are three major peanut-producing areas in the U.S.: (1) About half the acreage is in the Georgia-Florida-Alabama area, where about 60% of the peanut acreage is devoted to the Runner type and 1/3 to Spanish; (2) about 30% is in the Texas-Oklahoma area, almost all the Spanish type; and (3) about 20% is in the Virginia-Carolina area, which is devoted almost entirely to the large-seeded varieties of the commercial Virginia type. The fourth commercial market type, Valencia, is grown principally in New Mexico, on about 8,000 acres.

Use of Peanuts:

The Spanish type is used widely in peanut butter, salted peanuts, and candy. Runners are used mainly for peanut butter. The Virginia type is used mainly for fancy salted peanuts and roasted in the shell. Even though these are the preferred uses, most types are used interchangeably. More than half of the peanuts used as food in the United States go into peanut butter. Per capita consumption of peanuts and peanut products is about 5.5 lbs. per year. About 10% of the crop is exported. Price structures limit opportunities for export and for development of non-food uses.

B. Historical Developments

Peanut yields per acre have risen sharply in the last 20 years. In 1947 the average yield was 646 lbs. A new record average yield was set at

1,765 lbs. in 1967. The rapid rise in yield reflects increased use of fertilizer and herbicides, more effective control of diseases and insects, a shift to higher-producing varieties, higher plant population per acre, mechanization, and more irrigation.

Government effort to regulate peanut production to match effective demand and to support farm prices of peanuts began in the mid-1930's. Price support of peanuts became mandatory with legislation passed in 1941. Since 1957 the annual acreage allotment has been held to the 1.6 million acre legal minimum. Peanut acreage allotments on individual farms average about 15 acres. When quotas are in effect, peanut prices are supported between 75% and 90% of parity. The Commodity Credit Corporation has found it necessary to acquire from 15% to 30% of the crop in recent years in carrying out price support operations under existing legal provisions. These CCC stocks have been used for crushings, exports, and in some years for peanut butter for school lunches and the needy. Peanut support operations generally have been carried out at a loss to the CCC, currently about $50 million per year.

C. Marketing Procedures and Developments

As soon as the peanut crop is harvested, most growers deliver the in-shell peanuts directly to shellers, warehousemen, or processors. In 1965 an industry-wide marketing agreement became effective for the purpose of regulating the quality of peanuts marketed. A total of 88 peanut handlers, whose volume represented nearly all of the peanuts marketed in 1965-1966, participated as eligible handlers under this marketing agreement. On loads that meet specified minimum quality requirements but are not purchased by a sheller or processor, the CCC offers nonrecourse loans as the means of support prices to growers.

The program is administered by an 18-member industry committee. It consists of 3 producers and 3 handlers from each of the 3 major production areas; Virginia-Carolina, Southeast, and Southwest.

D. Research Perspective and Comments

The 1966 inventory of agricultural research shown in the Summary Table, page 5, indicates that 66 scientist-manyears (SMY) were devoted to research pertaining to peanuts in public agencies. This figure does not include mycotoxin research. The work was about half Federal and half State. The task force recommends increasing this effort to 131 SMY's in the next ten years, with a slightly greater acceleration in the State effort than the Federal. Subsequent to the completion of the long range study, a joint committee representing the Experiment Station Committee on Organization and Policy, and the USDA has been reviewing the SMY allocations. The first meeting of the joint committee was in July 1967. The allocations made at that meeting were used as a guide by the task

force and are shown in the Summary Table. The task force recommended greater increases than the joint committee in the areas of product development and quality and marketing. Some of the considerations leading to the recommended increases are discussed in the introductions to the sections on Product Development and Quality (Goal IV), page 38, and Marketing (Goal V), page 46.

Production exceeds demand

The major problem of the peanut industry is the inability to market the total production at established support prices that are deemed necessary to stabilize prices received by farmers. During the last decade, acreage has remained at 1.6 million acres but yield per acre has increased at twice the rate of increase in demand. The annual per capita consumption of peanuts increased by about one pound per person during the decade. This situation has led to increasing concern about the cost of the peanut price support program. The national policy of supporting farm prices through acreage control programs and commodity purchase programs is under critical review.

Research opportunities

Opportunities for research contributions to the peanut problem exist in two broad areas: (1) more efficient production that would lower the cost per unit of production; (2) new and improved products and more efficient processing and distribution that could increase consumption. Peanuts are an excellent source of human food and there should be an opportunity for further gains in consumption.

The Quality Problem

The problem of quality identification, measurement, and maintenance has been stressed for a number of years. The need is for (1) more accurate methods of determining quality of peanuts and (2) improved methods for grading raw peanuts. In 1963 the Peanut Improvement Working Group (PIWG), an organization of industry, State, and Federal personnel established in 1957 for the purpose of exchanging information, cooperative planning, and periodic review of all phases of peanut research and extension, stressed the need for standardized procedures for evaluating peanut quality. In 1964 a subcommittee of PIWG was appointed to develop such procedures. The quality problem is still unresolved; there is still a lack of objective methods for quality determination. In 1960 industry efforts were initiated for a laboratory devoted to quality. The laboratory will become a reality at Dawson, Georgia, as the Peanut Marketing Research Laboratory, by mid-1969. It should provide a central focus for stepped up work on quality involving a number of disciplines in line with the increased effort recommended in this report.

Research Encouraged

During 1968 the PIWG was reorganized and the name changed to the American Peanut Research and Education Association. The goals of the reorganized body are the same as those of the PIWG.

The National Peanut Council, organized in 1941, is made up of growers, primary processors, end-use manufacturers, and distributive agents. The Council was formed to promote, foster, and encourage increased consumption of peanuts. In an effort to stimulate research on peanuts the Council established the Golden Peanut Research Award in 1961. It consists of a trophy, $1,000 in cash, and a free trip for two persons to the annual convention. In 1968 the Council established within its organization a 5-man research and development committee representing different segments of the industry. This should provide a central industry focal point for communication with persons and groups responsible for publicly supported research.

General Comments

Finally, the task force recommends keeping the research program flexible so that projections made in this report can be adjusted through future planning and budgeting when new developments occur.

Each research problem area assigned to the Peanut Task Force is treated individually in the following sections of this report. The Summary Table on the next page shows the recommendations of the Task Force in terms of scientist-manyears for each research problem area assigned.

JOINT TASK FORCE ON PEANUT RESEARCH
Summary of Inventory and Recommended SMY's

Research Problem Area	1966 1/			1st 5-Year Period 2/			2nd 5-Year Period 2/		
	SAES	USDA	TOTAL	SAES	USDA	TOTAL	SAES	USDA	TOTAL
207 - Control of Insects	3	1	4	5	1	6	6	2	8
208 - Control of Diseases ...	8	3	11	11	4	15	15	5	20
209 - Control of Weeds	2	1	3	5	2	7	7	2	9
Subtotal - Protection	13	5	18	21	7	28	28	9	37
307 - Biological Efficiency .	9	2	11	13	3	16	23(17)	5(4)	28(21)
308 - Mechanization	2	2	4	3(5)	3(5)	6(10)	3(9)	4(5)	7(14)
309 - Systems Analysis				1	1	2	1	1	2
405 - Consumer Acceptability				1(2)		1(2)	3	0(1)	3(4)
Subtotal - Production	11	4	15	18(21)	7(9)	25(30)	30(30)	10(11)	40(41)
406 - Food Products	8	11	19	9(10)	12(13)	21(23)	11	16(19)	27(30)
407 - Feed & Nonfood Products		3	3		3	3		3	3
408 - Market Quality	2	5	7	2	5	7	3	6	9
Subtotal - Product Development & Quality	10	19	29	11(12)	20(21)	31(33)	14	25(28)	39(42)
501 - Grades and Standards ..		1	1		1(2)	1(2)		1(2)	1(2)
504 - Market Efficiency		3	3		3(6)	3(6)		4(9)	4(9)
Subtotal - Marketing		4	4		4(8)	4(8)		5(11)	5(11)
GRAND TOTAL	34	32	66	50(54)	38(45)	88(99)	72	49(59)	121(131)

1/ Inventory of Agricultural Research, Volume I, Table I, June 1967.

2/ A joint committee representing the Experiment Station Committee on Organization and Policy, and the USDA, met in July 1967, to review manpower allocations and recommended the SMY's shown without parentheses, the changes recommended by the Task Force are shown in parentheses.

Statement Concerning Mycotoxin Research for Food Safety Task Force

The presence in food and feed of fungal metabolites that are toxic to warm-blooded animals is an increasing source of concern to the Food and Drug Administration of the Department of Health, Education, and Welfare.

Aflatoxin, a metabolite of the fungus Aspergillus flavus that is toxic to certain warm-blooded animals, poses a serious threat to food safety in the United States and elsewhere in the world. About four per cent of the lots of domestic peanuts contained aflatoxin at levels in excess of 30 ppb in the 1967 crop, thus threatening the safety of an important food and the stability of the peanut industry. A. flavus occurs in peanut seed in all major areas of production, indicating a wide-spread potential for aflatoxin contamination of the seed. Certain species of domestic and experimental animals are highly susceptible, and the young are more susceptible than mature animals of any species. Toxicity may be acute or chronic, and carcinogenic or noncarcinogenic.

Peanut seeds support a rich and varied microflora. Few seeds are free of fungi at maturity. Many of these fungi are potentially toxigenic. Rats were killed in about half the tests within 5 to 7 days, when fed corn or corn and rice infested with Alternaria, Aspergillus, Chaetomium, Fusarium, and Penicillium isolated from peanuts. We do not know whether these fungi produce toxins when grown on peanuts.

At its meeting in January 1968, the Oilseed and Peanut Crops Research Advisory Committee urged the Secretary of Agriculture to give the highest priority to continuance and intensification of research on mycotoxins affecting peanuts and other commodities. This Committee, with membership from many segments of industry, recommended that such research should include investigation of the occurrence, origin, detection, effects, control, and removal of fungi and toxic fungal metabolites in peanuts and other agricultural commodities and their processed products. The Peanut Task Force concurs in these recommendations of the Research Advisory Committee.

The significance of activities within RPAs assigned to this Task Force to the probability of mold development and mycotoxin production has been recognized and is reflected in the recommendations. In addition, the Peanut Research Task Force urges the Food Safety Task Force to give a high priority to continued research on mycotoxins associated with peanuts and other agricultural commodities.

A. Protection of Peanuts During Production - Goal II

In the "National Program of Research for Agriculture" Goal II is to protect forests, crops, and livestock from natural and artificial hazards. With reference to crops, the program would involve seeking basic information on insects, diseases, weeds, and environmental hazards that cause losses in crops and developing effective economic means for their control or elimination.

This objective was broken down further into 14 research problem areas of which three were applicable to peanuts: RPA 207, Control of Insect Pests of Field Crops; RPA 208, Control of Diseases of Field Crops; and RPA 209, Control of Weeds and Other Hazards to Field Crops.

Insect, disease, and weed control is expected to continue as a major problem in peanut production. Recent research in the chemical control of leaf spot has been very encouraging. Symptoms of the disease have been virtually eliminated in several environments and on several varieties through use of new experimental chemical treatments. This progress will stimulate increased research to find other effective chemical pest controls.

The use of pesticides on peanuts, however, involves no less danger of degrading the environment or of inducing delayed detrimental side effects than do other pesticide uses. On the contrary, treatment of the peanut crop is especially sensitive because the edible product reaches the consumer with minimum processing. Opportunities to remove objectionable residues are therefore more limited than in the products of more involved processing procedures.

Breeding resistant genotypes has been a powerful means of disease control in other major crops. So far, genotypes with resistance to important peanut diseases have not been found in Arachis hypogaea, the cultivated peanut species. Resistance to important diseases has been found in other Arachis species, but the usefulness of such resistance requires as yet unknown methods of interspecific hybridization.

Opportunities of improving insect and weed control through breeding also exist. Present evidence suggests that insects show preference for certain peanut genotypes under experimental conditions. Plant breeding might contribute to weed control by emphasis on growth habit or other characters which would increase the competitive advantage of the crop over the weeds. There is the further possibility of breeding for greater tolerance to herbicides, thus widening the limits of herbicide treatments which could be used without crop damage.

CHARACTERIZATION AND BIOLOGY OF THE MAJOR BENEFICIAL AND PEST SPECIES OF PEANUT INSECTS

RPA 207-A

Situation: Insects cause heavy losses to peanut producers each year, and an additional item of production cost is spent on control. Many of the insects that attack peanuts also attack other crop plants. Although the biologies of some of these species (as well as of some insects beneficial to peanuts) have been studied in detail as they relate to other crops, little is known about the bionomics of many of these insects as they relate to peanuts. The biologies of both the major pests and their naturally occurring arthropod enemies must be understood before effective and efficient control measures, whether biological, insecticidal, or integrated, can be developed.

Objective: Determine the insect species present in the peanut field habitat and the seasonal population fluctuations of these species. Determine the nutritional requirements, intra-habitat distribution, mating habits, and other biological and ecological characteristics of the major insect pests and beneficial species in peanuts.

Research Approaches:

A. Sample the insect populations of peanut fields at various localities at regular intervals throughout the growing season. Identify the insects present and determine population fluctuations throughout the season.

B. Determine the effects of various insect populations at different times and under different growing conditions on yield and quality of peanuts and determine the economic injury thresholds.

C. Determine the seasonal habits (including mating, feeding, and migration), preference for alternate host plants, and population dynamics of the major peanut insects.

D. Coordinate research on a regional basis to assure complementarity of related programs.

Potential Benefits: Increased yield and quality of peanuts and reduced cost of production through a better understanding of the biology of the insects involved in peanut production. These benefits will accrue as knowledge gained here is utilized in RPA 207-B and 207-C.

Research Effort Recommended:

5-years	10-years
2	1

(Effort devoted to the research approaches during the early period will be shifted to RPA's 207-B and 207-C in the latter period.)

INSECTICIDAL METHODS OF CONTROLLING INSECTS

RPA 207-B

Situation: Some of our present control methods for peanut insects are unsatisfactory from the standpoint of cost, effectiveness, or safety. Despite efforts to develop noninsecticidal control programs, a continuing need for new insecticides will exist for the foreseeable future. Some chlorinated hydrocarbon insecticides are translocated to the seeds of some oilseed plants. Residues therefore pose hazards to the health of man and animals. Some insecticides reduce the population of beneficial parasites and predators to undesirable levels. There is a need for new insecticides which will be safe, effective, and low in cost.

Objective: To develop economic, effective, and safe chemicals to control insects in peanuts.

Research Approaches:

A. Evaluate new insecticides against major peanut insect pests in the laboratory and field.

B. Test various insecticide formulations, rates, and times of application using different types of ground and aerial equipment.

C. Evaluate the effect of insecticides on wildlife and beneficial insects.

D. Determine insecticidal residues at harvest in seed, oil, meal, and forage.

E. Coordinate with RPA 208, 209, 307, 308, 405, 406, 407, 408, and 701. (RPA 701, "Insure food products free from toxic residues from agricultural sources," was assigned to the task force on Food Safety. See also statement on mycotoxin in this report, page 6.

Potential Benefits: Safer and more effective use of insecticides would reduce residue hazards to health of man and animals, would increase yields and quality, and would lower the cost of control.

Research Effort Recommended:

5-years	10-years
2	3

NONINSECTICIDAL AND INTEGRATED METHODS OF CONTROLLING INSECTS

RPA 207-C

Situation: Public opposition to indiscriminate insecticide use is increasing. Unwise use of insecticides on peanuts in the past has led to undesirable insecticidal residue levels in the harvested crop. Insecticidal residues remaining in the soil may have an immediate or long-range deleterious effect on wildlife, or may enter the food chain through subsequent crops in the rotation. Researchers are currently seeking alternatives to complete dependence on insecticidal control. Some success has been achieved in developing noninsecticidal and/or integrated control programs for various crop pests. These programs are usually based on noninsecticidal control agents supplemented by the judicious use of insecticides that have been selected for specific desirable qualities. However, little attention has been given to these types of control programs on peanuts.

Objective: To develop noninsecticidal techniques for insect control, such as varietal resistance and biological control agents. To develop integrated control programs utilizing minimal insecticide use combined with noninsecticidal control agents.

Research Approaches:

A. Collect and evaluate peanut germ plasm for insect resistance.

B. Transfer resistant germ plasm to adapted varieties.

C. Determine the chemical, physiological, or morphological nature of resistance and the inheritance of these factors.

D. Determine the effectiveness of peanut insect parasites, predators, and pathogens as field control agents. Develop techniques for mass rearing the more promising agents and study the effect on pest species of field releases of these organisms.

E. Conduct tests to determine if the major peanut insect pests can be sterilized with radiation, chemosterilants, or other methods, and determine if the sterile male release technique can be used for area-wide control.

F. Determine the presence of and isolate sex attractants from major peanut insect pests and conduct field tests on the feasibility of controlling these insects by the use of these or other attractants.

G. Combine these various techniques with limited insecticidal applications for integrated insect control programs suitable for use by peanut farmers.

H. Coordinate with RPA 208, 209, 307, and 308.

Potential Benefits: Reduce cost of production and increase yield and quality. Reduce insecticidal residue problems.

Research Effort Recommended:

5-years	10-years
2	4

CONTROL OF DISEASES THROUGH BREEDING AND GENETICS

RPA 208-A

Situation: Average annual losses in yield caused by peanut diseases, excluding nematodes, for the period 1951-60, were estimated to be 28 percent of production. Peanut diseases are still a major limiting factor in production. The best control for plant diseases is resistant or tolerant varieties. Little usable genetic resistance or tolerance to disease has been identified in peanuts. Apparent immunity or resistance to Cercospora leafspots, rosette, peanut rust, nematodes, and possibly peanut stunt virus has been found in certain wild species of Arachis. However, these wild species cannot be crossed successfully with cultivated peanuts. Means of transferring genes for resistance from wild species to cultivated peanuts are being sought but success to date has been meager.

Objective: Develop improved varieties of peanuts with resistance to diseases.

Research Approaches:

A. Screen all available peanuts for resistance or tolerance to principal peanut diseases.

B. Determine nature and manner of inheritance of resistance or tolerance to diseases.

C. Incorporate usable resistance or tolerance identified under A. into commercially desirable types by breeding.

D. Devise procedures whereby genes for resistance to peanut diseases in wild species of Arachis can be transferred to cultivated peanuts, and incorporate such resistance into desirable commercial varieties.

E. Coordinate with RPA 307.

Potential Benefits: Decrease in losses in yield and quality from diseases and consequent lower cost per unit of production of peanuts of higher quality and greater consumer appeal. Time required for breeding and genetic studies is such that little of the great potential in this research will be realized in the next 10 years. Over a period of 20 years a 10 percent increase in yield is not an unreasonable expectation.

Research Effort Recommended:

5-years	10-years
3	4

CONTROL OF PEANUT LEAFSPOTS

RPA 208-B

Situation: Peanut leafspots, principally those caused by the fungus Cercospora, are a continuing problem in peanut culture. These diseases are responsible for the greatest single loss of peanut productivity due to disease. Present control measures, which are based on the periodic application of fungicides, are only partially successful. Additionally, cost of chemical control of leafspot is increasing while the incidence of the disease is increasing slightly due to higher plant populations and inadequate rotations. Genetic resistance is not available.

Objective: To develop integrated control practices which utilize chemical, cultural, and genetic methods of reducing losses from leafspots.

Research Approaches:

A. Study the effects of a variety of natural and synthetic chemicals, including proprietary and nonproprietary materials, on the incidence of peanut leafspots and leaflet persistence.

B. Identify genotypes that possess some degree of resistance to leafspots and incorporate such resistance into commercial varieties.

C. Determine physical and biochemical nature of resistance.

D. Identify the common sources of primary inoculum and devise measures to reduce this inoculum.

E. Survey natural epiphyllous microorganisms to determine if organisms can be found that are antagonistic on the leaf surface to leafspot pathogens.

F. Determine differences in A-E between the two prominent species of Cercospora.

G. Develop a control system utilizing every increment of control benefit available from chemicals, genetic resistance, and other factors.

H. Coordinate with RPA 207, 209, 307, and 308.

Potential Benefits: Increase in yield and quality of peanuts.

Research Effort Recommended:

5-years	10-years
3	4

SEED AND SEEDLING DISEASES

RPA 208-C

Situation: Peanut seeds are highly susceptible to injury and invasion by microorganisms. Microorganisms in and on the seed and in the soil may attack peanut seed during early stages of germination and emergence causing considerable stand reduction and possibly necessitating replanting. In addition, plants which are attacked during germination may survive until they become established seedlings and then die. Some pathogenic fungi, such as Rhizoctonia, readily attack established, older seedlings and decimate stands. Seed and seedling diseases cause an estimated 5 percent annual loss in yield on the farm.

Objective: To reduce pre-emergence losses and control organisms which attack established seedlings.

Research Approaches:

A. Evaluate seed treatment fungicides and other chemicals for control of pre- and post-emergence losses and attempt to find highly effective but relatively nontoxic treatments.

B. Study, by field and laboratory experiments, the etiology of diseases caused by individual effects of fungi, bacteria, and nematodes and combinations of these organisms on seed germination and seedling establishment.

C. Determine the effects of decomposing plant residues on seed germination and seedling vigor.

D. Assess the value of in-furrow or soil-incorporated pesticides for control of seedling diseases.

E. Determine the method of entry and usual sites of infection of peanut seed by fungi and bacteria with particular emphasis on the role of the seed coat as a barrier to infection or as a reservoir of quiescent microorganisms.

F. Study mechanisms of survival and persistence of microorganisms affecting seed and seedlings.

G. Coordinate with RPA 207, 209, 307, and 308.

Potential Benefits: Increase in yield due to more adequate population of vigorous productive plants.

Research Effort Recommended:

5-years	10-years
2	3

ETIOLOGY AND CONTROL OF STEM, ROOT, AND POD DISEASES

RPA 208-D

Situation: Diseases which affect peanut stems, roots, and pods are due to attacks by a wide variety of fungi, bacteria, and perhaps other microorganisms. Stem diseases such as those caused by Sclerotium, Rhizoctonia, Botrytis, and Pseudomonas commonly kill plants at an advanced stage of growth. Root diseases such as those caused by Pythium and Rhizoctonia cause stunting, poor yields, or death. Pods of plants which survive the hazards of root and stem diseases are subject to attacks by fungi, such as Pythium, Rhizoctonia, and Thielaviopsis, and bacteria. In most instances root, stem, and pod losses from disease organisms occur toward crop maturity so that considerable grower investment is lost. Diseases in this category cause estimated annual losses in yield of 12 percent and a reduction in quality of peanuts produced.

Objective: To gain a thorough understanding of the diseases affecting stems, roots, and pods and to devise control measures for the diseases.

Research Approaches:

A. Study life cycles of pathogens and their interrelationships with other pathogens, parasites, and saprophytes and their survival.

B. Investigate the effects of interactions of plant debris and microorganisms in the soil on root deterioration.

C. Determine the ecological succession of microorganisms on roots and pods during growth of the plant.

D. Evaluate soil-incorporated proprietary pesticides and other soil amendments for their effectiveness in controlling disease organisms.

E. Study methods of land preparation, crop culture, and crop rotation schemes for their value in disease control.

F. Coordinate with RPA 207, 209, 307, 308, 405, 504, and 702. (RPA 702, "Protect food supplies from harmful microorganisms and naturally occurring toxins," was assigned to the task force on Food Safety. See also statement on mycotoxin in this report, page 6.)

Potential Benefits: An understanding of the life processes of pathogens will lead to more effective and economical methods of control. This will in turn be reflected in greater yield and production efficiency and higher quality in the end product.

Research Effort Recommended:

5-years	10-years
4	5

ETIOLOGY OF VIRUS DISEASES OF PEANUT

RPA 208-E

Situation: Virus diseases have not significantly affected peanut production in the United States until recently, although they are limiting factors to peanut production in some areas of the world. Stunt virus, which was discovered several years ago in the United States, poses a threat to the industry. Infection by other less obvious virus diseases by transfer from other host species is a continuing threat.

Objective: To identify and study virus diseases of peanut, and to develop suitable control measures.

Research Approaches:

A. Determine the identity and characteristics of viruses from peanut.

B. Study host-virus interactions and determine the host range of viruses from peanut.

C. Study virus-vector relationships to identify vectors and establish methods of transmission.

D. Evaluate peanut genotypes for resistance to infection and disease by individual viruses or combinations of viruses and incorporate resistance, or tolerance, into commercial types.

E. Develop practical procedures to control virus diseases that adversely affect peanuts.

Potential Benefits: This activity will aid in solution of pressing virus disease problems and may prevent losses that would occur in absence of the information.

Research Effort Recommended:

5-years	10-years
1	1

CONTROL OF NEMATODES IN PEANUTS

RPA 208-F

Situation: In all peanut-producing areas, nematodes cause reduced yield and quality. Losses attributable to two species of root-knot nematodes amount to 3 percent; other species such as sting, lesion, and ring nematodes may account for an additional 3 percent loss, with total estimated annual loss of $18 million from nematodes. Exact figures on distribution of nematodes and losses are not available. Nematodes also incite plant diseases such as peg rot, reduce efficient use of fertilizers and water, and reduce quality of peanuts. Control programs must be developed for each nematode species for different soil and peanut types in the several production areas. More effective nematode control could be achieved with better information on control of specific species of nematodes as affected by cropping practices, cultural practices, chemical control, and development of resistant varieties. At present there are no resistant peanut varieties.

Objective: To develop adequate systems of cultural, biological and chemical control for specific nematodes in peanuts.

Research Approaches:

A. Study cropping sequences and other management practices to determine the effects of various practices on nematode populations.

B. Develop nematicides for effective control of nematodes and integrate chemical control with other means of control.

C. Determine interrelations of nematodes with diseases caused by fungi, bacteria, and viruses.

D. Identify sources of resistance and develop peanut varieties with resistance to root-knot, lesion, ring, and sting nematodes.

E. Coordinate with research in RPA 207, 209, 307, and 308.

Potential Benefits: Increase peanut yields and quality by reducing nematode injury.

Research Effort Recommended:

5-years	10-years
2	3

CONTROL OF WEEDS IN PEANUTS

RPA 209

Situation: Losses in yield and quality in peanuts caused by weeds and cost of control total an estimated $50 million a year. Some annual weeds, such as crabgrass, Florida purslane, and pigweed can now be controlled in peanuts at acceptable cost with several combinations of cultural practices and herbicides. These measures appear less effective in the Southwest than in the Southeast and Virginia-North Carolina areas. In all areas, however, there are serious weeds that are not controlled effectively by current methods.

Uncontrolled weeds reduce yields, impair quality, and increase wear and breakdown of harvesting equipment. Cultivation for control of weeds sometimes increases the losses from diseases, particularly southern blight. Herbicides now used for control of weeds sometimes injure the peanuts; and this is a significant loss even though it is usually less than the damage the target weeds would cause in the absence of treatment.

Currently, herbicides are available for use early in the season. No herbicides are registered for application in mid- or late-season. Some control techniques, now under investigation, require precision that is unobtainable with present equipment.

Objective: To develop effective and economical systems of controlling those weeds that cannot be controlled economically with current practices; reduce losses resulting from injury to peanuts by herbicides.

Research Approaches:

A. Evaluate new herbicides and develop better herbicide application techniques to improve the efficiency and safety of weed control with herbicides.

B. Study the comparative physiology, anatomy, and ecology of peanuts and problem weeds to discover inherent differences that can be utilized in control methods, and to discover weak points in the life cycle of weeds.

C. Develop rotational systems involving other crops and varied control practices that will bring several types of control treatments to bear on specific weeds.

D. Characterize the effects of weeds on peanuts to increase our ability to set better priorities on research targets.

E. Conduct limited research to characterize persistence of herbicides in soil, and to discover possible interactions between herbicides, and between herbicides and other agricultural chemicals.

F. Coordinate with RPA 207, 208, 307, 308, and 701.

Potential Benefits: Increase peanut yields by reducing weed competition and losses due to injury by control methods. Reduce cost of production. Reduce cost of harvesting. Provide alternate systems of control to prevent build-up of weeds resistant to a single system.

Research Effort Recommended:

5-years	10-years
7	9

B. Efficient Production of Peanuts - Goal III

In the "National Program of Research for Agriculture" Goal III is the production of an adequate supply of farm and forest products at decreasing real production costs. The objective was further broken down into 16 research problem areas of which three were applicable to peanuts: RPA 307, Biological Efficiency of Field Crops; RPA 308, Mechanization of Production of Field Crops; and RPA 309, Systems Analysis in Production of Field Crops. In addition, RPA 405, Production of Field Crops with Improved Consumer Acceptability, is applicable to peanuts and is more appropriate to discussion in this section than with Goal IV.

The problems of peanut producers and, indeed, of the entire industry come to a focus in the phrase "production efficiency." The high cost of production increases management risks, leads to short-cuts which may degrade crop quality, and limits the options available to the producer. Many of the producer's costs are relatively fixed. Unit costs are therefore inversely related to productivity. Peanut yields have risen dramatically, nearly tripling in the last 20 years. The increase has reflected improved technology in varieties, weed control, fertilization, irrigation, mechanization, and other aspects of management. The large percentage increase, however, reflects the very low average yields of 20 years ago. Average peanut yields today are ordinary in comparison with other crops on a tonnage basis, or even on an energy basis, which weights the comparison in favor of peanuts. Some typical average yields as a percentage of shelled peanut yields are: corn, 365; rice, 370; barley, 190; wheat, 140; soybeans, 132. Peanuts constitute a greater concentration of energy than these crops, so with comparable biological efficiency peanuts should produce smaller tonnage. On a stored energy per acre basis, the following percentages of peanut energy storage are estimated: corn, 225; rice, 240; barley, 108; wheat, 86; soybean, 95.

These comparisons illustrate that while important gains in peanut productivity have been achieved, present yield levels are not outstanding. Further improvements are needed. The farmer is the original systems analyst. However, the business of farming has become so complex that it demands the most advanced techniques for the farmer to effectively select among varieties, cultural practices, and the many other management decisions open to him. Research in the RPA's in Goal III is directly in the mainstream of the broad objectives of improving the lot of the industry and the consumer.

BREEDING AND GENETICS FOR HIGHER YIELD AND QUALITY

RPA 307-A

Situation: Average yield per acre of peanuts has nearly tripled within the past 20 years. An estimated 20 to 25 percent of the increase can be attributed to higher yielding varieties. Much greater progress is possible in this field. Progress in variety improvement has been limited by lack of knowledge of inheritance of quantitative and other economic characters. The genetic base for high yield potential in present varieties and advanced breeding lines is narrow and should be broadened. Usually 12 to 15 years elapses between time a cross is made and a new variety developed therefrom begins to make an appreciable impact at the grower level.

Objective: To develop through breeding peanut varieties with higher yield potential and improved quality.

Research Approaches:

A. Screen cultivated peanuts and wild species of *Arachis* for traits that could increase yield and quality of cultivated peanuts.

B. Seek ways of successfully incorporating higher yield potential and improved quality into agronomically desirable varieties.

C. Develop varieties that combine higher yield potential, improved quality, multiple resistance or tolerance to destructive diseases and insects and other pests and pesticides, adaptation to mechanical harvesting and curing, and other desirable agronomic attributes.

D. Ascertain the nature of inheritance of characters of economic importance in peanuts to improve breeding efficiency.

E. Investigate methods of breeding to identify ways to increase gain per breeding cycle and to reduce time for each cycle.

F. Devise procedures to make possible transfer of desirable traits in wild species to cultivated peanuts.

G. Coordinate with RPA 207, 208, 209, 308, 405, and 408.

Potential Benefits: Increase in yield potential and a lower cost per unit of production of peanuts of higher quality and greater consumer appeal.

Research Effort Recommended:

5-years	10-years
6	8

INCREASING YIELD AND QUALITY BY MANAGEMENT PRACTICES

RPA 307-B

Situation: Inadequate irregular stands of plants of substandard vigor often limit yield of peanuts. Information available of effect on yield and quality of seed vitality, seed size, seedling vigor, method of land preparation and planting, date and depth of planting, row width, plant populations, rotation sequences, fertilizer, soil type and pH, and method of curing is incomplete and often seemingly contradictory. Peanut varieties differ in earliness and growth habit, size of pods and seed, and the way they interact with environmental conditions. Supplemental irrigation for peanuts is increasing. In many areas where irrigation is needed, water is limited. It should be determined whether at some stage or stages in its development the peanut plant can withstand moderate water stress without injury and thus make possible reduced water usage per unit of production.

Objective: To develop integrated management practices to increase the efficiency of production of peanuts of higher quality.

Research Approaches:

A. Evaluate method of land preparation and planting, date and depth of planting, row width, plant populations, rotation sequences, fertilizer, and soil type and pH, in relation to yield and quality of representative varieties and types of peanuts grown in the major producing areas.

B. Evaluate production and curing environments in relation to their effect on seed vitality and vigor of plants that develop from seed grown and cured in these environments.

C. Evaluate effect of seed vitality and seed size on seedling emergence, vigor, and plant productivity under a wide range of planting and production environments.

D. Determine the time and amount of water to apply at various stages of growth for maximum yields and quality per unit of water with a limited or abundant supply of water.

E. Investigate the effect on yield and quality of moisture stress at various stages of growth at different depths of the root zone.

F. Identify in each major producing area the combination of variety and management practices which gives the highest yield and quality of peanuts at the lowest cost per unit of production.

G. Coordinate with RPA 105, 106, 207, 208, 209, 308, 405, and 408. (RPA 105, "Conservation and efficient use of water for agriculture," and RPA 106, "Efficient drainage and irrigation systems and facilities," were assigned to the task force on Water and Watersheds.)

Potential Benefits: Increased production and a lower cost per unit of production of peanuts of higher quality. Conservation of water.

Research Effort Recommended:

5-years	10-years
5	6

PHYSIOLOGY OF FLOWERING AND FRUITING

RPA 307-C

Situation: The peanut has a unique reproductive system that is poorly understood. Flowers are borne above ground, but pods and seeds develop at the end of slender pegs 1 to 3 inches below the soil surface. Flowering extends over a period of 6 to 10 weeks, and consequently seeds of wide range of maturity are present on a given plant at digging. Under certain environmental conditions plants may flower but pegs do not elongate immediately. The fertilized ovules in the ovary may remain quiescent but fully functional for 10 days to several weeks, and when environmental conditions favorable for peg elongation occur, many pegs may elongate more or less simultaneously.

Objective: To develop an understanding of the effect of environmental conditions on growth and fruiting of peanuts.

Research Approaches:

A. Identify the chemical reaction or reactions that are significant in fruit set and peg elongation.

B. Investigate the effect of soil and air temperature, relative humidity, light intensity and duration, soil moisture, air movement, and mineral nutrition, individually and in various combinations, on flowering and fruiting of different types and varieties of peanuts.

C. Devise practical procedures to control peg elongation at will under field conditions without adversely affecting plant development and performance.

D. Investigate usefulness of growth regulating chemicals for modifying growth habit of peanut plants without adversely affecting their reproductive potential, or to modify plant performance in other ways.

Potential Benefits: Increased yield at lower cost per unit of production of peanuts of higher quality.

Research Effort Recommended:

5-years	10-years
3	3

FERTILIZATION AND NUTRIENT RELATIONSHIPS

RPA 307-D

Situation: The erratic and sometimes negative response of the peanut plant to direct applications of fertilizer is a universal problem and at present is a primary factor in limiting yields of this crop. The problem is common to both infertile and moderately fertile soils. Micronutrient deficiencies occur in many peanut soils, but the degree of deficiency and the areas involved are poorly defined. There are indications that high levels of phosphorus will reduce zinc uptake and inhibit fruiting. The Virginia type responds more readily to calcium additions than Spanish. Varieties within these types have not been carefully studied for differential response to calcium and other nutrient additions. The soil factors that govern the release of elements are unidentified.

Objective: To find out why peanuts do not respond to fertilizers in a predictable and positive manner and to develop fertilization techniques to increase peanut productivity.

Research Approaches:

A. Determine feasibility of improved nutrient supply to the plant through mineralization of soil organic matter with high fertilization rates applied to a preceding winter cover crop or other crop grown in rotation.

B. Study the effect of various amounts of nutrient elements in the soil on the uptake of nutrients, the translocation of nutrients within the plant, and interactions in effects of the nutrients.

C. Differentiate between the root zone and peg zone requirements for each essential element and determine optimum placement depth of fertilizer materials.

D. Compare nutrient response of different genotypes and determine whether useful heritable variation exists; if so, incorporate desirable nutrient characters into commercial varieties.

E. Develop suitable tissue test criteria to determine the nutrient status in the plant parts and determine tissue levels associated with deficient, normal, and abundant or toxic levels.

F. Coordinate with RPA 102, 207, 208, 209, and 308. (RPA 102, "Soil Structure; and soil, plant, water, and nutrient relationships," was assigned to the task force on Soil and Land Use.)

Potential Benefits: Increase yields and reduce unit cost of production by more effective utilization of applied nutrients.

Research Effort Recommended:

5-years	10-years
2	4

MECHANIZATION TO INCREASE PEANUT PRODUCTION EFFICIENCY

RPA 308-A

Situation: Present management practices require burial of previous crop litter in order to control leaf spot diseases. Equipment now available is such that precise and deep burial is hard to achieve. As a result, buried litter often interferes with sub-surface placement or incorporation of herbicides and reduces planting precision. Equipment to do a better job of deep burial is needed.

Planters which will accurately place peanut seed at high speed are not available.

Better equipment or alternate methods of incorporating pesticides are needed in order to achieve more efficient use of chemicals, reduce pesticide residue hazards, and reduce number of operations required for pesticide treatment.

Objective: To develop equipment and practices which will reduce production costs and insure vigorous productive plants that are free of weeds at harvest time.

Research Approaches:

A. Investigate alternative means of land preparation and planting to insure precise and deep burial of litter.

B. Develop planters or methods by which planting operations can be accomplished faster and more precisely.

C. Investigate methods of applying pesticides which will reduce number of applications and quantity applied or increase effectiveness of pesticides.

D. Coordinate with research in RPA 207, 208, 209, 307, 309, 405, and 408.

Potential Benefits: Lower unit costs for producing high quality peanuts. Reduce man and machine time through use of multi-row equipment. Accurate planting will reduce number of seed required and provide improved stands. Pesticide application method improvement will reduce both time and herbicide cost. In addition, savings in more effective disease and pest control and in the other associated RPA's will accrue.

Research Effort Recommended:

5-years	10-years
4	5

MECHANIZATION TO INCREASE PEANUT HARVESTING AND EFFICIENCY

RPA 308-B

Situation: Peanuts are normally harvested in two distinct steps. First, the taproot is cut and the vines are lifted from the soil, shaken, and deposited in a windrow for initial curing and drying. After several days in the windrow, the pods are separated from the vine by a combine and the curing and drying process is completed under controlled conditions. Losses in the harvesting operation are estimated as high as 20 percent of total potential yield. Present harvesting equipment causes considerable damage to the peanuts, resulting in additional financial loss to the producer due to reduction in grades. Harvesting equipment capable of gentler handling is needed. Harvesting capacity now greatly exceeds the drying capacity. This often causes delays of 3-4 days between the time of harvesting and drying. During this time, the peanuts are very susceptible to quality deterioration and to attacks by toxin-producing molds. Existing drying equipment does not dry peanuts uniformly nor at even temperatures, reducing quality and sometimes enhancing opportunities for mold growth.

Objective: To develop harvesting and farm-processing equipment and practices which reduce harvesting losses and damages due to both mechanical and biological causes.

Research Approaches:

A. Determine nature and extent of present losses and damages.

B. Redesign components and practices to allow present machines to operate more efficiently and with less damage to the peanuts.

C. Develop new concepts into more efficient harvesting machines.

D. Develop methods and equipment for more efficient drying and curing of peanuts.

E. Coordinate with RPA 207, 208, 209, 307, 309, 405, and 408.

Potential Benefits: Lower unit costs of producing high quality peanuts through reduction of losses and damages, by reducing the losses and damages incurred in the harvesting operations and by better quality maintenance through improved curing and drying.

Research Effort Recommended:

5-years	10-years
6	9

SYSTEMS ANALYSIS FOR PEANUT PRODUCTION

RPA 309

Situation: Peanut producers must choose from several alternative varieties, planting times, row spacings, plant populations, type and capacity of harvesting and drying equipment. The proper selection of the crop production system would provide for the optimum use of labor, capital, and machine capacity as influenced by weather probabilities, field condition, and time within the context of the total farm organization. Few, if any, farms are devoted exclusively to peanut production. Hence, peanuts must compete with other crop and livestock enterprises for the use of scarce resources. Mathematical models are needed to simulate alternative production systems in order to compare the profitability of various alternatives and their compatibility within the total farm organization.

Objective: To combine that set of production practices, equipment, capital investments, and labor availability for peanut production that will maximize net returns under typical resource situations.

Research Approaches:

A. Adapt or develop and use mathematical models for simulating the peanut production to identify factors requiring additional research.

B. Evaluate alternative systems of producing, harvesting, and drying peanuts, including prospective new systems envisioned in other RPA's, and their impact on capital and labor requirements within the context of the total farm organization and alternative resource uses.

Potential Benefits: Reduced unit production costs of unknown magnitude.

Research Effort Recommended:

5-years	10-years
2	2

PRODUCTION OF PEANUTS WITH IMPROVED CONSUMER ACCEPTABILITY

RPA 405

Situation: The assortment and characteristics of food available to consumers change constantly with the adoption of new practices of production, processing, and marketing. The acceptability of peanuts depends on external attributes such as shape, size, and color and on more subjective attributes such as flavor, aroma, chemical composition, and shelf-life. As objective methods of measuring preference factors are developed, producers will know what kind of a product to produce. This information can be used to modify the plant by breeders, to adjust cultural, handling, curing, and marketing practices. Consumer acceptability factors have not received their needed attention in plant breeding programs.

Objective: To develop varieties or practices to produce peanuts of improved nutritive value, flavor and flavor stability, and processing quality.

Research Approaches:

A. Identify factors important to buyers and consumers.

B. Determine production practices that affect buyer and consumer acceptability.

C. Identify genotypes containing significant chemical constituents in higher or lower than normal concentrations and use such genotypes to breed agronomically superior peanut varieties with superior composition.

D. Determine the significant environmental effects during crop production on the levels of chemical constituents of special importance in consumer acceptability, flavor, nutritive value, and processing quality.

E. Develop new or improved analytical techniques appropriate to evaluate the above factors.

F. Coordinate with RPA 307.

Potential Benefits: Increased consumption of peanuts because of enhanced consumer appeal.

Research Effort Recommended:

5-years	10-years
2	4

C. Product Development and Quality - Goal IV

In the "National Program of Research for Agriculture," Goal IV is to expand the demand for farm products by developing new and improved products and processes and enhancing product quality. Within this objective the research effort would be aimed at (1) developing varieties and strains of crops having attributes that meet the preferences and desires of consumers; (2) improving production practices, processing methods and marketing procedures so as to preserve or enhance inherent qualities of farm products; (3) developing new and improved products from agricultural commodities by tailoring products to meet customer preferences and by increasing product utility for the consumer per unit of input.

The objective was further broken down into 12 research problem areas of which three will be discussed in this section: RPA 406, New and Improved Food Products; RPA 407, New and Improved Feed, and Nonfood Products; and RPA 408, Quality Maintenance in Marketing. RPA 405, pertaining to production for consumer acceptability is discussed in the previous section.

In the introduction to this report reference was made to the excellent value of peanuts as human food. The amount of protein in 1 lb. of peanuts is equal to 14 oz. cooked round steak. The per capita consumption of 5.5 lbs. of peanuts provides 1.4 lbs. of protein. This amount is equivalent to the total adult requirement for nine days, as recommended by the Food and Agriculture Organization (FAO).

Peanut meal is a byproduct of peanuts crushed for oil. It contains about 50% protein and is a good livestock feed. In view of relative product values, however, priority for research should place major emphasis on food uses. The situation is different for peanut hulls, a byproduct of the shelling industry. Peanut hulls traditionally have been used for livestock feed, fertilizer conditioners, fuel, and poultry litter. In recent years the use of pesticides during the production process has practically eliminated the markets for hulls as a livestock feed and poultry litter. The sudden loss of markets for hulls has left peanut shellers with a serious problem of disposal. A solution of this residue problem would contribute significantly to avoidance of additional environmental pollution.

The need for quality identification, measurement, and maintenance has been discussed in the introduction. The Quality Committee of the PIWG reiterated the need for objective standards in 1966 as did the Oilseed and Peanut Crops Research Advisory Committee at its 1968 meeting. Members of the task force were of the opinion that increased uses of peanut products are vital to future well-being of the industry. By increasing consumption, new peanut products would extend the benefits of the high nutritional values of peanuts to consumers. The task force recommends an increase of 13 SMY's for research on Product Development and Quality.

PEANUT PRODUCTS OF IMPROVED FLAVOR AND FLAVOR RETENTION

RPA 406-A

Situation: Roasted peanuts and peanut butter are eaten primarily because of their appealing aroma and flavor, although they are also sources of good quality protein. Improvements in roasted peanut flavor and retention of fresh roasted flavor on aging are needed to increase markets for edible peanut products. The nature of flavor changes during and subsequent to roasting is relatively unknown. Staling is an important deterrent to increased consumption. Knowledge of the flavor components determinable through newer analytical methods would guide changes in pre-processing, processing, and storage and marketing techniques to improve flavor, control staling, and increase consumer acceptance.

Objective: To develop means of assuring improved flavor and flavor retention in peanut products.

Research Approaches:

A. Identify components responsible for the characteristic flavor and aroma of freshly roasted peanuts.

B. Develop methods for concentrating components of fresh roasted peanut flavor.

C. Evaluate the role of native or added enzymes in peanut curing in relation to flavor precursors and other quality factors.

D. Develop procedures to stabilize and enhance fresh roasted peanut flavor.

E. Determine peanut and oil quality in terms of fatty acid composition, content of tocopherols, and other minor components.

F. Coordinate with RPA 207, 208, 209, 307, 308, 405, and 408.

Potential Benefits: Stabilization and enhancement of the characteristic, appealing flavor of freshly roasted peanuts should increase their use in peanut butter, confections, and as snack items for domestic markets and for export to developed countries. Roasted peanuts of improved and more permanent flavor could be expected to have an increased value at little or no added processing cost.

Research Effort Recommended:

5-years	10-years
8	12

NEW AND IMPROVED FOOD PRODUCTS FROM PEANUTS

RPA 406-B

Situation: Peanuts contain a high content of good quality protein but current food use is limited almost exclusively to a few products - peanut butter, roasted or salted peanuts, and confections. There is an increasing need for low-cost protein foods that are nutritious and attractive not only in the United States but throughout the world. Peanuts are adaptable to preparation of a wide variety of high protein products from fat-free to 50% fat, from bland to highly flavored, and in physical states adaptable to nearly any dietary system.

Objective: To develop improved processes for and food products from full-fat and partially defatted peanuts, peanut flour, and oil.

Research Approaches:

A. Develop full-fat and partially defatted peanut, peanut flake, flour, blended, and textured products.

B. Develop high-protein, low-fat peanut flours, concentrates, and isolates for food use.

C. Develop fermented or cheese-like products from peanuts.

D. Determine protein quality (protein efficiency ratios and net protein utilization) of selected products developed under A., B., and C. above.

E. Develop new information on the composition and functional, physical, and immunochemical properties of peanut protein and their relation to other constituents.

F. Coordinate with RPA 307, 405, and 408.

Potential Benefits: Development of new and improved food products, partially defatted products, flours, and blends with other food ingredients should increase utilization in the culinary arts. Inexpensive protein would be available for incorporation in foods and beverages, thus improving nutrition of low income groups and providing additional domestic markets. Availability of such products would provide opportunity for expanding present limited exports of peanut products by opening new markets in developed countries. Better methods for separation of low quality peanuts should ensure consumer acceptance and freedom from deleterious contaminants.

Research Effort Recommended:

5-years	10-years
15	18

NEW AND IMPROVED FEEDS AND NONFOOD PRODUCTS FROM PEANUTS

RPA 407

Situation: Surplus and off-grade peanuts are crushed for recovery of oil and meal, some by pressing but most by prepress solvent extraction. The oil is refined to produce a cooking oil. The meal is suitable for incorporation into ruminant, nonruminant, or poultry feeds, if essentially free of aflatoxin, but if contaminated with aflatoxin may not be used for feed and is usually diverted to fertilizer use. Hulls constitute a disposal problem, since peanut hulls may be contaminated with pesticides and in some areas are infested with insect pests and nematodes. Some hulls are burned, but some are used as filler in fertilizers, roughage in cattle feed, poultry litter, and mulch, and small amounts are used in industry, e.g. as abrasives. Burning of hulls adds to air pollution.

Objective: To develop improved feeds and nonfood products from peanut processing.

Research Approaches:

A. Develop processing methods to extract oil more efficiently and to remove toxins or other deleterious factors from peanut meal.

B. Determine factors limiting the feed efficiency of peanut meals and develop means of improving feed efficiency of the meal.

C. Explore use of peanut oil as a raw material for fabricating industrial products.

D. Determine pharmacology of constituents and derivatives of peanut oil and meal.

E. Determine and develop commercial uses of peanut hulls.

F. Coordinate with RPA 207, 208, 209, 307, 405, and 701

Potential Benefits: More economical and efficient processes for conversion of peanuts to oil and meal, improved quality of the major products, new nonfood products from oil and meal, and improved utilization of peanut hulls should improve nonfood utilization of peanuts and peanut products, assist in control of insect pests and reduce air pollution. The benefits from destruction of insect pests, and decreased air pollution by eliminating the need to burn peanut hulls should be significant.

Research Effort Recommended:

5-years	10-years
3	3

QUALITY MAINTENANCE OF PEANUTS AND THEIR PRODUCTS DURING MARKETING

RPA 408

Situation: Harvested peanuts are subject to deterioration in quality and loss in value through insect and fungus attack and contamination, development of mycotoxin, normal metabolic changes, and instability of their oil constituents to atmospheric oxygen.

Most of the 2.5 billion pounds of farmers' stock peanuts produced annually in the United States are combined from windrows at high moisture contents and must be dried carefully to avoid damage.

Information is needed on the biology, ecology, and control of the various insects and fungi that attack peanuts, and on the physical and chemical changes and the environmental factors which influence these changes during handling, storage, transportation, and processing. Methods are needed to detect chemical residues and other quality deterioration factors. Also needed are methods and equipment for detection of fungi and insects during storage and marketing.

Objective: To determine optimum conditions and quality maintenance procedures for peanuts during the marketing process.

Research Approaches:

A. Investigate the biology, ecology, and behavior of stored-peanut insects for devising new approaches to controls; determine the relationship between insect infestation and fungal contamination in peanuts.

B. Develop safe, effective insecticide and noninsecticide treatments that will prevent undesirable residues.

C. Determine physical and biochemical changes of peanuts during the marketing process and their relationship to storage methods.

D. Develop simple, practical, and objective methods of determining quality attributes.

E. Determine types, methods, and procedures for packaging peanuts and their products to assure maintenance of quality.

F. Coordinate with RPA 207, 208, 209, 307, 308, 405, and 701. (RPA 701, "Insure food products free from toxic residues from agricultural sources" was assigned to the task force on Food Safety. See also statement on mycotoxin in this report, page 6.)

Potential Benefits: Prevention of quality deterioration and product loss during marketing and assurance of top quality food. Better control of storage insects and diseases, reduced pesticide hazard, improved quality resulting from better handling and drying, and objective methods of determining quality attributes would contribute to improved quality, reduced losses, and savings of time and labor.

Research Effort Recommended:

5-years	10-years
7	9

D. Efficiency in the Marketing System - Goal V

In the "National Program of Research for Agriculture," Goal V is "Efficiency in the Marketing System. This Goal is broken down into 10 research problem areas, of which two were assigned to this task force. They are RPA 501, Improvement of Grades and Standards; and RPA 504, Physical and Economic Efficiency in Marketing Field Crops.

There is considerable opportunity for marketing research to contribute to reducing the price spread for peanuts between the farmer and the consumer. Improvements in marketing efficiency should help make peanuts more attractive to the consumer, which in turn should help increase demand for them. An indication of the limited attention given to marketing in public agency programs may be observed in the Summary Table and a review of the papers given at the Peanut Improvement Working Group meetings. Over a 10 year period during which some 150 papers or program topics were presented at meetings only 10 items pertained to marketing, and five of these were given in 1960.

Members of the task force were of the opinion that the health of the peanut industry and interests of consumers require greater emphasis on research on marketing efficiency. Reflecting their judgment of the importance of these RPA's, the task force members recommend an increase of seven SMY's above the 1966 inventory.

IMPROVEMENT OF GRADES AND STANDARDS FOR PEANUTS

RPA 501

Situation: The use of grades and standards in our marketing system has resulted from the need for a common language understood and used by sellers and buyers as a basis of judging the quality of a product in relation to its price. Present methods of identifying and describing the quality of peanuts are inadequate.

Conditions under which peanuts are being grown, harvested, dried, and handled on the farm, and methods of conditioning, handling, storing, and transportation of the crop after it reaches the market have changed greatly during the past 20 years. Present grades and standards for peanuts do not fully reflect the true value components of the crop. Among other things, objective and convenient methods are needed for measuring seed maturity, shelling and processing quality, and the presence of objectionable fungal metabolites.

Objective: To provide grades and standards that will effectively communicate value differences for varying gradations of peanut quality.

Research Approaches:

A. Develop techniques, methods, and equipment for rapidly determining quality factors of peanuts in marketing channels.

B. Evaluate present grade factors and possible revisions to reflect changes in buyer demands and consumer preferences.

C. Develop a uniform system of grades recognizing those characteristics which reflect value and affect use.

D. Coordinate with RPA 207, 208, 209, 307, 308, 405, 408, 504, and 701.

Potential Benefits: Effective grades and standards are necessary for buyers to obtain product characteristics desired and for sellers to obtain appropriate compensation for what they sell. Accurate description of products should provide more reliable market information to sellers and buyers. Prices should more accurately reflect value differences for varying gradations of quality.

Research Effort Recommended:

5-years	10-years
2	2

PHYSICAL EFFICIENCY IN MARKETING PEANUTS AND THEIR PRODUCTS

RPA 504-A

Situation: Differences in varieties of peanuts and the environments of producing areas where they are conditioned and stored, together with advancing techniques in cultural and harvesting practices, require new or modified marketing facilities, equipment, and methods. Such changes are essential to the efficient and economical handling, conditioning, storing, and transportation of peanuts and their products to maintain their quality. There is a need for improved designs and facilities based on functional and structural requirements that will expedite the movement of peanuts (both shelled and in-shell) into, within, and out of the facility and through marketing channels. There is also a need for handling, drying, and conditioning equipment that will minimize the extent of physical damage (breakage) to peanuts as they are handled into, within, and out of marketing facilities and to merchandising outlets.

Objective: To reduce the cost of marketing peanuts and maintain product quality through better equipment for drying, conditioning, handling, and storage, improved transportation procedures, and efficiency in marketing operations.

Research Approaches:

A. Evaluate organization and management practices in relation to cost of marketing peanuts and their products.

B. Determine relationship of equipment design, plant layout, and handling methods for drying, conditioning, handling, storing, and preparing for market on product quality and marketing costs.

C. Develop new or improved equipment for drying, conditioning, handling, storing, and preparing for market to improve the quality of the product and reduce marketing costs.

D. Develop physical methods such as use of aerodynamic principles to sort shelled or unshelled peanuts.

E. Determine the effect of transportation equipment design and performance and methods of transportation on marketing and processing costs, product loss, and end product quality.

F. Develop packaging and transportation methods and techniques to maintain product quality and reduce transportation costs.

G. Coordinate with RPA 308, 309, 408, and 501.

Potential Benefits: Reduce the total costs of conditioning, storage, processing, and distribution of the national peanut crop and maintain the highest quality of the product.

Research Effort Recommended:

5-years	10-years
5	7

ECONOMIC EFFICIENCY IN MARKETING PEANUTS AND THEIR PRODUCTS

RPA 504-B

Situation: In most transactions between buyer and seller the negotiation has three important elements--quantity, quality, and price. Price is the common denominator of most marketing transactions. Effectiveness of the pricing system depends largely on how rapidly and accurately prices reflect such factors as weight, grades, quality, competition, and other price determinants, and how rapidly and accurately processors and others can evaluate and act upon this information. The typical farmer as well as most other entrepreneurs in the peanut industry lack the resources to collect and analyze all the statistical and economic information necessary for making sound production and marketing decisions.

There is need to evaluate the influence of such things as size, number, type of firm, and the potential ease of entry of new firms into the business. Information is needed on the interrelationships among prices, production, and consumption of farm products, and other factors. Similarly Congress and the administrators of farm programs need economic information to evaluate existing and alternative policies in terms of their probable impact on production, consumption, farm income, and consumer costs.

An understanding of consumer reactions and the reasons behind them is essential to planning improvements in the production, processing, and marketing of peanuts and their products, and for developing educational programs, setting or revising grades and standards, or evaluating new products.

Objective: To provide a continuing evaluation of the economics of the marketing system for peanuts with special emphasis on market organization, competition, pricing, market information and communication, equity, and consumer preferences.

Research Approaches:

A. Determine the most efficient and economical system for handling, transporting, storing, and distributing peanuts and their products--including the type, design, size, and location of facilities.

B. Evaluate the overall structure and performance of peanut markets, including studies of prices, marketing costs, margins, competition, market information, practices, and services.

C. Determine relationship of firm size, composition of products, and marketing and processing costs in marketing peanuts and their products.

D. Evaluate the economic impacts of marketing innovations, new or improved products, and market development for peanuts and their products in both domestic and foreign markets.

E. Evaluate consumer response to new products, packages, and methods of handling.

Potential Benefits: Economic efficiency should insure an adequate supply of peanuts to meet the demands of consumers and reward producers equitably for a good job of production. Adequate and reliable market information should contribute to sound decisions by all persons involved.

Research Effort Recommended:

5-years	10-years
1	2